Although most adults were captured from the upper river, they were not distributed equally throughout the reach. Catch rates in two segments of the upper reach — known as the 18-mile reach (RM 154–171) and the 15-mile reach (RM 171–185) — were five to six times higher than in the lower third of the reach (Osmundson 2000). These reaches contain 8 to 10 times more adult Colorado pikeminnow per mile than the lower 100 mile of the Colorado River.

Osmundson (2002a) repeated the population estimate for the 1998–2000 period using the same techniques used by Osmundson and Burnham (1998). He also revised the previous estimate using length criteria for adults corresponding to recovery goals established in 2002 (USFWS 2002c; ≥450 mm total length [TL]) and provided a river-wide estimate. Average population size for the Colorado River was 503 adult Colorado pikeminnow for 1992–1994 and 604 for 1998–2000 (Osmundson 2002a). Although the average point estimate increased for the second period, the difference was not significant because of wide confidence intervals. An increase in the adult population during the 1990s was also suggested by an increasing catch rate during spring ISMP electrofishing (Figure 3.6; McAda 2002a). However, electrofishing catch rates dropped off in 1999 and 2000, whereas population estimates did not.

Density and distribution of YOY Colorado pikeminnow have been monitored in the Colorado River since 1982 (McAda and Ryel 1999). Density has been highly variable over that period, but YOY have been captured every year since monitoring began. Highest density of YOY Colorado pikeminnow occurred in 1985, 1986, and 1996 and lowest density occurred in 1984, 1995, and 1997. Young-of-the-year Colorado pikeminnow were found throughout the Colorado River downstream from the confluence with the Gunnison River, but were most abundant in the 65 mile between Moab and the mouth of the Green River. Although larval Colorado pikeminnow were collected upstream of the mouth of the Gunnison River in 1982 (McAda and Kaeding 1991b) and in 1995 (Anderson 1999), no YOY and only one yearling have ever been captured there (Osmundson and Burnham 1998). The number of YOY captured in the river between the mouth of the Gunnison River and Westwater Canyon has decreased since the mid 1980s, with no YOY Colorado pikeminnow captured upstream from Westwater Canyon during autumn ISMP surveys since 1992 and only one captured each year from 1988 to 1992 (McAda and Ryel 1999). However, more intensive seining collections than done under ISMP captured one YOY Colorado pikeminnow in 1997 and one in 1998 in the Grand Valley downstream from the Gunnison River (K. Bestgen, personal communication).

Density of YOY Colorado pikeminnow was greatest in the lowest gradient reaches of the Colorado River, similar to distributional patterns in the Green River (Tyus and Haines 1991). This lower 60 miles of the river has a large number of backwaters and embayments (although not the largest, or the highest concentration of backwaters) and the warmest water temperatures in the Colorado River upstream from Lake Powell (Osmundson 1999). Backwaters are warmer and more productive than the rest of the river (Wydoski and Wick 1998), and they provide important nursery habitat for small Colorado pikeminnow during the first year of their life (Tyus and Haines 1991).

On December 19, 2001, UDWR personnel identified backwater areas that may be used by larval and juvenile pikeminnows beginning at the mouth of Moab Wash and extending approximately 1,200 ft south. Within this area, three locations extending about 600 to 800 ft south of the wash were tentatively identified as having the greatest potential for suitable nursery habitat at river flows that inundate these areas each year.

As part of the ISMP, pikeminnow nursery habitat was sampled each fall (1986 to 2002) between river mile 53.5 and 63.5. The purpose of this sampling was to determine relative abundance and distribution of young-of-the-year Colorado pikeminnow. The sampling protocol required sampling two habitats every 5 miles. Sixty backwater locations were sampled between 1986 and 2002, of which 13 were between river mile 61 and 63.5. Five of the 13 backwater areas sampled contained a total of 83 young-of-the-year pikeminnow comprising 24 percent of the total pikeminnow captured between river mile 53.5 and 63.5 during ISMP sampling (UDWR 2003a).

In the spring of 2003, USF&WS captured 8 stocked adult pikeminnow between river miles 60 and 64, 4 between river miles 64 and 70, and 20 between river miles 50 and 60 (USF&WS 2004b).

Razorback Sucker

In the Colorado River upstream from Lake Powell, most razorback suckers have been captured in the Grand Valley (Loma, Colorado to Palisade, Colorado) near the confluence of the Gunnison and Colorado rivers. However, their abundance has decreased to the point that they are only infrequently captured there. During intensive efforts specifically targeted at known concentration areas, Kidd (1977) and McAda and Wydoski (1980) captured a combined total of 54 razorback suckers in 1974 and 204 in 1975 from two gravel-pit ponds connected to the Colorado River near Grand Junction. These numbers reflect the combined total of independent collections, but probably include some recaptures of the same fish because sampling was done in the same areas and Kidd (1977) did not mark fish before release. All of these fish were adults that exhibited signs of old age such as large size, missing eyes, and heavy scarring (C. McAda, personal observation).

A variety of investigators have sampled the Colorado River in subsequent years, but sampling effort varied considerably and sampling did not always target razorback sucker. The high numbers of razorback suckers captured in 1975 were not repeated in subsequent years (summarized by Osmundson and Kaeding 1991). The highest number captured in later years was 30 fish that were collected in 1982 from the same gravel-pit ponds sampled by Kidd (1977) and McAda and Wydoski (1980). Total fish captured declined dramatically after 1975, and few wild razorback suckers have been captured in recent years. Only 11 wild razorback suckers have been collected in the Grand Valley since 1990 despite intensive sampling in some years (Osmundson and Kaeding 1991; CDOW and USFWS, unpublished data). All of these fish were removed from the river to support propagation activities for the Recovery Program (M. Baker, unpublished data).

Although most razorbacks suckers have been collected in the Grand Valley, they have also been collected both up and downstream of the area. Kidd (1977) reported 22 razorback suckers from the Colorado River near DeBeque, Colorado (RM 209.7) in 1974–1975. No razorbacks have been collected from that reach since then (Valdez et al. 1982b; Burdick 1992). Burdick (1992) captured one razorback sucker from a gravel pit pond along the river at RM 234.8 and discovered a small population in another gravel-pit pond at RM 204.5. About 75 razorback suckers were captured from the second pond, but DNA analysis revealed that they were siblings. They were probably offspring from two or three razorback suckers trapped in the pond during the high-water years of 1983 or 1984. Three razorback suckers from this pond were incorporated into the propagation program, but their close relationship precluded extensive use in the brood-stock program. Forty-five razorback suckers from this pond were equipped with radio transmitters and stocked into the Colorado and Gunnison rivers as part of an experimental stocking; six of those fish were confirmed alive at the end of the 2-yr study (Burdick and Bonar 1997).

Few razorback suckers have been captured downstream from the Grand Valley, between Loma and Lake Powell. Taba et al. (1965) captured eight juveniles in backwaters of the Colorado River downstream of Moab. One adult was captured near Salt Wash (RM 144.2) in 1988 (McAda et al. 1994b). Further downstream, Valdez et al. (1982b) captured two razorback suckers within 2 mileof the confluence with the Green River, and Valdez (1990) captured one more in the same area.

The only small razorback suckers reported from the Colorado River were captured by Taba et al. (1965), who found eight juveniles (90–115 mm TL) in “quiet backwater areas” during a 2-yr survey of the river between Moab and Dead Horse Point. That observation is consistent with collections of juveniles from the Green River. Gutermuth et al. (1994) captured two age-0 juveniles in backwaters along the lower Green River in 1991, and Modde (1996) found two in similar habitats in the middle Green River in 1993. Most recently, Modde (1996) found age-0 juveniles in an experimental flooded bottomland (Old Charlie Wash) along the middle Green River when it was drained at the end of the growing season — 28 in 1995 and 45 in 1996.

Although razorback suckers have declined dramatically in abundance in recent years, the Recovery Program considers the Colorado and Gunnison rivers to be suitable habitat for razorback suckers and has begun a reintroduction program to restore populations in the two rivers (Burdick 1992; Nesler 1998; Hudson, et al. 1999).

The Recovery Program is still building a broodstock for future use, but about 19,000 razorback suckers have been stocked into the Gunnison River near Delta and about 44,000 razorbacks have been stocked into the Colorado River upstream from Grand Junction (Burdick 2003; C. McAda, personal communication). Initial surveys indicate that some of the stocked fish are surviving in the Gunnison and Colorado rivers near their stocking location, and others have moved and are surviving further downstream in the Colorado River (Burdick 2003). In 2003, USFWS captured 3 stocked adult razorback suckers between river miles 60 and 64, 10 between river miles 64 and 70, and 8 between river miles 50 and 60 (USFWS 2004b). USFWS sampled this stretch of river in the spring of 2004 and captured 6 stocked adults between river miles 64 and 70, 2 between river miles 60 and 64, and 3 between river miles 45 and 60 (USFWS 2004c). This reintroduction program is scheduled to continue until a self-sustaining population of at least 5,800 individuals is established in the Gunnison and upper Colorado Rivers (USFWS 2002d). Some of the stocked razorback suckers have survived to adulthood and spawned successfully — a total of eight larval razorback suckers were captured from the Gunnison River in 2002 (Osmundson 2002b).

Bonytail

Few bonytails have been captured from the upper Colorado River since intensive sampling began in the 1970s, even though anecdotal and photographic evidence suggest that they were common in the river early in this century (Quartarone 1993). Valdez et al. (1982b) did not capture bonytails during an intensive 3-yr study of the Colorado River between Rifle and Lake Powell. Kaeding et al. (1986) captured one adult at Black Rocks near the Colorado-Utah state line, and Valdez (1990) captured 14 *Gila* spp. from Cataract Canyon that were suspected to be bonytails (1 YOY, 7 juveniles, and 6 adults).

The Recovery Program began a reintroduction program in 1996 and has stocked about 84,600 bonytails into the Colorado River since then (Badame and Hudson 2003). Developing a self-sustaining bonytail population in the upper Colorado River will require accomplishments in all phases of the Recovery Program including nonnative fish control, habitat restoration, and instream flow protection. Recaptures of these stocked individuals have been increasing in recent years throughout the river, including near the Moab Site (USFWS 2004a). In 2003, a stocked adult bonytail was captured by USFWS at river mile 66.2, just upstream of the Moab Site (USFWS 2004b). In 2004, a stocked adult was captured at river mile 69.2. (USFWS 2004c). Recovery goals call for a self-sustaining population of 4,400 adults in the upper Colorado River (USFWS 2002a).

Because of its extreme rarity, little is known about the habitat requirements of bonytail in the upper Colorado River. However, all four of the endangered fish evolved together in the Colorado River ecosystem, and flow recommendations and water quality needs based on habitat requirements of the more common species and basic river restoration principals (Stanford et al. 1996) should also benefit bonytail.

Humpback Chub

Two major populations of humpback chub are found in the upper Colorado River — Black Rocks, a 1-mile long reach just upstream from the Colorado-Utah state line, and Westwater Canyon, an 18-mile long canyon-bound reach of rapids, deep pools, and violent eddies. The two populations are generally considered to be distinct because they are separated by about 11 mi, but movement between the two populations has been documented (Valdez and Clemmer 1982; Kaeding et al. 1990; Chart and Lentsch 1999a; McAda 2002b).

Both populations have been sampled regularly since the late 1970's and were generally considered to be stable, with annual reproduction and regular recruitment of young fish to the adult population (Valdez and Clemmer 1982; Kaeding et al. 1990; McAda et al. 1994b; Chart and Lentsch 1999a). However, quantitative population estimates have not been attempted until recently. Chart and Lentsch (1999a) sampled Westwater Canyon during 1993–1996 and made population estimates based on year-to-year recaptures at three discrete sites within the canyon. Sampling was restricted to the three sites because rapids and violent eddies made sampling very difficult in the rest of the canyon. The average annual population estimate for the three sites combined was 6,985 adults (Chart and Lentsch 1999a). A more intensive, mark recapture estimate conducted from 1998–2000 period determined the population declined from 4,744 adults to 2,201 adults in 2001 (Hudson and Jackson 2003). The average adult population size for Black Rocks during 1998–2000 was estimated to be about 740 individuals (McAda 2002b). Decline in catch rates suggest that the population has decreased, but annual population estimates are not significantly different from each other (McAda 2002b).

Adult humpback chubs in the upper Colorado River are relatively sedentary and generally remain within a small area (Valdez and Clemmer 1982; Kaeding et al. 1990; Chart and Lentsch 1999a). Displacement of radiotagged humpback chubs in Black Rocks averaged 0.5– 0.9 mile (Valdez and Clemmer 1982; Kaeding et al. 1990), and displacement of fish tagged with carlin tags averaged 0.7–1.0 mile(Valdez and Clemmer 1982; Kaeding et al. 1990).

Thirty-two percent of the humpback chubs tagged and recaptured by Kaeding et al. (1990) were recaptured at their release site, and 80% were recaptured within 0.3 mile of it. However, they recaptured two humpback chubs that had originally been tagged in Westwater Canyon, about 14 mile downstream. Valdez and Clemmer (1982) also reported movement of a humpback chub from Westwater Canyon upstream to Black Rocks.

The majority (82%) of fish tagged and recaptured by Chart and Lentsch (1999a) in Westwater Canyon showed no net movement, although some fish moved among the three sampling sites. Among others, they recaptured two fish only 2 d after being tagged at Black Rocks. The abrupt downstream movement may have been precipitated by handling stress (Chart and Lentsch 1999a). In addition, seven humpback chubs originally tagged in Westwater Canyon by Chart and Lentsch (1999a) were recaptured in Black Rocks (McAda 2002b). Intervals between tagging and recapture varied from 1 to 6 yr; there is no way to determine how long the fish had been in Black Rocks or how long it took them to move 14 mile upstream. One of these fish was recaptured a second time in Black Rocks 1 yr after its first recapture (C. McAda, unpublished data).

A third population, the Cataract Canyon population is located some 70 miles downstream in Canyonlands National Park. Densities of humpback chubs in Cataract Canyon are much lower than those reported from Black Rocks or Westwater Canyon.   Three weeks of sampling in Cataract Canyon during the fall of 2003 resulted in the capture of 32 individual humpback chub (Valdez et al 2003).

Young-of-the-year humpback chubs have been collected from a variety of low-velocity habitats within Westwater Canyon, including shorelines, backwaters, and embayments (Chart and Lentsch 1999a). They used low-velocity habitats as they were available with very little selection of specific habitats (Chart and Lentsch 1999a). In Black Rocks, small humpback chubs were collected from backwaters as well as small, quiet pockets along the steep rock walls (Valdez and Clemmer 1982).

Factors Affecting the Species Environment Within the Action Area

Designated critical habitat for both Colorado pikeminnow and razorback sucker includes the Colorado River and its 100-year floodplain throughout the project area. Designated critical habitat for the humpback chub and bonytail is located approximately 50 miles upstream of the project and approximately 60 miles downstream. Primary constituent elements include, but are not limited to, water (in sufficient quantity and quality to sustain all life stages), physical habitat, and the biological environment (including competition and predation with nonnative species).

Impoundments and diversions have reduced peak discharges in various river reaches throughout the Upper Colorado River Basin since the 1890's, while increasing base flows in other reaches. These depletions, along with a number of other factors, including the introduction of nonnative fishes and increases in salinity and contaminants in the system, have resulted in such drastic reductions in populations of Colorado pikeminnow, humpback chub, razorback sucker and bonytail chub that the USFWS has listed these species as endangered, designated their critical habitats, and has implemented programs to prevent them from becoming extinct.

The numerous impoundments in the upper Colorado River, including Granby, Dillon, Blue Mesa and McPhee Reservoirs, have altered the natural hydrograph of the Colorado River. Reductions in water quantity and changes in flow regime have resulted from upstream developments (USFWS 1993a). A comparison of the frequency of the $Q_{1.5}$ peak flow (a river flow that was equaled or exceeded in 2 out of 3 years) at the Colorado River at the USGS gage near Cisco, Utah (the closest upstream gage) for three development periods (1914-1936, 1937-1965, and 1966-1997) declined from 37,200 cfs to 27,900 cfs to 21,600 cfs (summarized in McAda 2003). Changes in the hydrologic regime through the closure of main stem impoundments has altered sediment transport and resulted in channel degradation (Lyons 1989). Changes in the hydrograph can also lead to changes in the channel geometry. Reduction in channel width has increased the average velocity in the main channel and decreased the number of low-velocity backwaters (Wick et al. 1982). Important backwater habitats and low-velocity shoreline habitats have been eliminated through siltation and subsequent vegetative growth (Wick et al. 1982). In particular, river shorelines have been altered by establishment of the exotic plant tamarisk (*Tamarisk chinensis*). For example, in Canyonlands National Park, the establishment of tamarisk on islands, sandbars, and river shorelines has decreased channel width by an average of 25 percent (Graff 1978). All these species can be found to varying degrees in the project area.

The impoundment of tributaries and mainstem waters also has led to the stocking of a number of nonnative sport and bait fishes for use by local residents and visitors to the basin. While the acceptance of these fishes has been generally favorable to the public, their presence has led to predation, competition, and the general demise of native species (Tyus 1990, Tyus and Saunders 1996). The stocking of nonnative warm water fishes such as channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieu*), and walleye (*Stizostedion vitreum*) have resulted in the continuing high probability of predation on native fishes. Red shiners (*Cyprinella lutrensis*), for example, have been documented as preying on larval suckers, including razorbacks (Rupert et al. 1993, Modde 1997). Other exotics such as sand shiners (*Notropis stramineus*) and fathead minnows (*Pimephales promelas*) compete for food and space in remaining habitats. Some scientists believe (Tyus and Saunders 1996) that changes in the biological environment as a result of fish introductions may currently be the most significant threat to the native fish fauna of the Colorado River basin.

Water quality has been altered in the Colorado River Basin and also has been identified as a factor resulting in the decline of the endangered fishes. Both the Draft Razorback Sucker Recovery Plan (USFWS 1997) and Colorado Squawfish (name later changed to Colorado pikeminnow) Recovery Plan (USFWS 1991) identify changes in water quality and introduction of environmental contaminants as factors in the decline of the endangered fish. While several general trends in water quality changes have been identified for the Colorado River system (for example, increasing pH and decreasing turbidity), the water quality parameters and environmental contaminants of concern to the endangered fish tend to be site specific. In the USFWS's Recovery Goals for the Colorado pikeminnow, razorback sucker, and bonytail (USFWS 2002a-c) the Atlas Mill tailings are recognized as posing two significant threats: a). toxic discharge of pollutants, particularly ammonia, and b). the risk of catastrophic pile failure that could bury important nursery areas. Quantifiable criteria required to downlist these species include:

> Task E-2.1.- Identify actions to remediate groundwater contamination from the Atlas Mills tailings pile located near Moab, Utah, in order to restore water quality of the Colorado River in the vicinity of the pile in accordance with State of Utah and Environmental Protection Agency (EPA) water quality standards for fish and wildlife.

Quantifiable criteria required to delist these species include:

> Task E-2.2.- Implement actions (as determined under Task E-2.1) to remediate groundwater contamination from the Atlas Mill tailings pile.

The nearest U.S. Geological Survey water quality monitoring station on the mainstem Colorado River to the Atlas site is approximately 31 river miles upstream near Cisco, Utah. The site is located on the left bank of the Colorado River one mile downstream of the Dolores River confluence, 11 miles south of Cisco, Utah, 36 miles downstream from the Utah-Colorado state line. This site has been continuously monitored by the U.S. Geological Survey since 1928. Baseline water quality data for the Colorado River upstream of the Atlas site, at the Cisco station, is included in Table 3 below. While the data is included as baseline, it should be noted that several washes (Salt, Negro Bill, and Courthouse), and Creeks (Onion, Professor, Stearns, and Castle) contribute flows to the Colorado River between the Cisco station and the Atlas site. Therefore, water quality in the Colorado River just above the Atlas site may, at times, be slightly different than that reported for Cisco.

Table 3. Baseline water quality data for the Colorado River, recorded at Cisco, Utah (Water Year 2000).

Date	Discharge (Inst. CFS)	Sulfate Dissolved (mg/l as SO4)	Chloride Dissolved (mg/l as CL)	Nitrogen NO2+NO3 Dissolved (mg/l as N)	Nitrogen Ammonia Dissolved (mg/l as NH4)	Arsenic Dissolved (ug/l as AS)	Beryllium Dissolved (ug/l as BE)	Cadmium Dissolved (ug/l as CD)	Manganese Dissolved (ug/l as MN)	Molybdenum Dissolved (ug/l as MO)	Selenium Dissolved (ug/l as SE)	Uranium Natural Dissolved (ug/l as U)
11/02/99	5920	240	72	0.289	--	<2	--	--	--	--	4	--
12/01/99	3900	260	100	0.500	--	--	--	--	--	--	4	--
12/16/99	3770	250	95	0.530	--	<2	<1.0	<1.0	17.0	5.6	3	5.7
03/29/00	3970	240	110	0.356	0.05	<2	<1.0	<1.0	1.5	6.8	4	4.4
04/27/00	8080	120	41	0.317	--	--	--	--	--	--	<2	--
05/23/00	10200	120	36	0.270	--	<2	<1.0	<1.0	<1.0	2.8	--	2.6
06/27/00	5950	170	59	0.319	--	<2	--	--	--	--	3	--
07/20/00	3930	250	83	0.668	0.03	<2	--	--	--	--	4	--
08/28/00	3760	310	75	0.784	--	--	<1.0	<1.0	<1.0	7.2	5	6.6
09/07/00	3760	290	81	0.700	--	--	--	--	--	--	4	--

The following constituents were detected at DOE’s background monitoring site CR-1(located upstream of the Moab Site and upstream of the Hwy 191 bridge; at the cement boat ramp): aluminum, ammonia, arsenic (very low), barium, boron, calcium, chloride, fluoride, gross alpha, gross beta, iron (unfiltered only), lithium, magnesium, manganese, molybdenum (very low), nickel (very low), nitrate, polonium-210, potassium, radium-226 (low), selenium, sodium, strontium, sulfate, TDS, uranium, vanadium, and zinc (very low). Constituents that were analyzed but not detected included antimony, beryllium, bismuth, cadmium, chromium, cobalt, elemental lead, lead-210, mercury, radium-228, radon-222, silver, thallium, thorium-230, phosphate, and tungsten. Detectable constituents and concentration ranges at background locations for samples collected during SMI and DOE sampling events from April 2000 through December 2002 are presented in Table 4 (reproduced from DOE 2003).

Table 4. Constituent concentration ranges collected immediately upstream of the Moab Site.

Constituent	**Frequency of Detection**	**Range (mg/L except as noted)**
Major Ions		
Calcium	16/16	46.3–141
Chloride	20/20	25.1–172
Magnesium	16/16	12.9–41
Potassium	16/16	2.1–5.3
Sodium	17/17	30.5–125
Sulfate	20/20	84.1–439
Total Dissolved Solids	12/12	430–1060
Minor Constituents		
Aluminum	9/12	0.008–0.14
Ammonia, total as N	9/20	Nd–0.134
Arsenic	8/11	Nd–0.002
Barium	13/13	0.051–0.14
Boron	4/10	Nd–0.123
Copper	3/13	Nd–0.0014
Fluoride	3/3	0.3–0.504
Gross Alpha	1/7	Nd–13.82*pCi/L
Gross Beta	2/7	Nd–13.78**pCi/L
Iron	6/9	Nd–4.17**
Lithium	1/3	Nd–0.0557
Manganese	8/18	Nd–0.076
Molybdenum	17/18	Nd–0.007
Nickel	7/10	Nd–0.002
Nitrate as NO3	6/6	0.776–5.51
Polonium-210	2/5	Nd–0.1142 pCi/L
Radium-226	5/5	0.12–0.23 pCi/L
Selenium	15/15	0.0013–0.0079
Strontium	10/10	0.965–1.63
Uranium	20/20	0.0023–0.008
Vanadium	11/11	0.0007–0.0031
Zinc	5/12	Nd–0.006

EFFECTS OF THE PROPOSED ACTION

Current Conditions

Surface contamination

In 2001, DOE began radiometric characterization of soils on the millsite. To date, the area north and northeast of the tailings pile have been assessed. Most of the site exhibits soil contamination exceeding EPA standards for radium-226. Exceptions are some small areas north of the tailings pile and one larger area northwest of the pile where a borrow pit was excavated and soils were used for pile surcharge (i.e., weight on the pile to squeeze out moisture) and for the interim cover. Shallow contamination was also identified north of US-191 on DOE property extending to the property line with Arches National Park.

Depths of contamination range from 6 to 120 inches. The area outside the tailings pile (i.e., the area of windblown contamination) is estimated to contain 71,000 yd^3 of contaminated soils. Measuring the depth of contamination with surface scanning and downhole logging instruments has inherent uncertainties; experience at other UMTRCA sites suggests that the final volume could exceed the volume characterized by a range of 50 to 100 percent.

On the basis of site knowledge and past UMTRCA site experience, DOE estimates that 11.9 million tons (8.9 million yd^3) of contaminated materials exist at the Moab Site and vicinity properties. Table 5 presents a summary of the contaminated materials and quantities present at the Moab Site and nearby vicinity properties. Additional investigations confirmed that most of the slimes are located in the center of the pile and are surrounded by sandy tailings.

Table 5. Contaminated Material Quantities

Source Material	**Volume (yd^3)**	**Weight (dry short tons)**
Uranium mill tailings	7,800,000	10,500,000
Pile surcharge	445,000	600,000
Subpile soil	420,000	566,000
Off-pile contaminated site soils	173,000	234,000
Vicinity property material	29,400	39,700
Total	**8,867,400**	**11,939,700**

The tailings pile at the Moab Site contains waste residuals from the milling operation. Milling involved both acid and carbonate processing methods (i.e., circuits). Lime was added to the tailings to neutralize the acid-milled tailings. Chemicals used in the processing, including acids, ammonia, and solvents, are incorporated with the silicate grains. Many other minerals, including sulfates and sulfides, are also present in lesser amounts. It is difficult to determine the residence time of the contaminants, although there is evidence that some exist as siliceous mixtures, and others may exist as sulfides, selenides, molybdates, and uranium minerals. Contaminants are also likely to be adsorbed to minerals, especially iron oxyhydroxides.

Bulk chemical analysis of the tailings solids indicates that high concentrations of ammonia, uranium, and radium-226 are present. The mean radium-226, ammonia (as N), and uranium concentrations for the tailings are 516 pCi/g, 423 milligrams per kilogram (mg/kg), and 84 mg/kg, respectively. The finer grained (slimes and silt) fractions have more radium-226 and uranium but less ammonia as (N) than the sand fraction. Other constituents, including iron, manganese, copper, lead, molybdenum, selenium, and vanadium, are present in lesser amounts. The pH values of the tailings are near neutral but have zones of pH values as low as 2.5 and as high as 10. The tailings have a small amount of acid-generating capacity in the form of sulfide minerals. The oxidation-reduction potential is not well defined by existing data, and conditions may vary spatially from relatively oxidizing to relatively reducing.

Mean tailings pore water concentrations for radium-226 and uranium are 61.1 picocuries per liter (pCi/L) and 15.1 mg/L, respectively. The average tailings pore water concentration for ammonia (as N) is 1,100 mg/L. Pore water is a mixture of residual milling fluids and water that infiltrated later into the tailings. The pore water appears to be relatively oxidized, although few data are available to assess oxidation-reduction potential. The pH value of the pore water is near neutral, and the mean TDS concentration is 23,500 mg/L. Values of pH, oxidation state, and availability of soluble minerals in the tailings are the main parameters that affect the composition of pore water. Concentrations of organic constituents used in the mill processing circuit are negligible in the pore water. Concentrations of all constituents are much higher in samples of water collected in a shallow-depth sump fed by pore water extracted from the tailings through wick drains than in any of the pore water samples collected from deeper SRK (2000) wells. Analyses of samples collected from the sump indicate the presence of a salt layer in the upper portion of the pile (DOE 2003).

Two underground septic tanks (size unknown) that supported past operations but are no longer used are located inside the radioactively contaminated portion of the site northeast of the historical warehouse. It is unknown if there are buried leach fields associated with these tanks. Organic contamination in soil and ground water samples was not detected by DOE in an analysis performed as part of the site characterization for the SOWP (DOE 2003a).

<u>Ground water contamination</u>

Ground water occurs in the bedrock formations and unconsolidated Quaternary material deposited on the floor of Moab and Spanish Valleys. The Navajo Sandstone, Kayenta Formation, and Wingate Sandstone of the Glen Canyon Group contain the principal bedrock aquifer in the region and locally are present only upgradient at the northern boundary of the site. The Navajo Sandstone of the Glen Canyon aquifer ranges in thickness from 300 to 700 ft (Doelling et al. 2002) and is the shallowest and most permeable formation in the Glen Canyon Group. Wells located 7 to 8 miles southeast of the site produce in excess of 1,000 gpm of high-quality water from the Navajo Sandstone for the city of Moab water supply.

Most of the freshwater in the basin-fill aquifer enters the site from Moab Wash and along geologic contacts between the alluvium and the Glen Canyon Group bedrock present at the north boundary of the site. The bedrock in this area is highly fractured and faulted from incipient collapse of the Moab anticline caused by dissolution of the underlying Paradox Formation salt core of the anticline.

Ground water elevation contours east of the Colorado River in the Matheson Wetlands Preserve based on March 2003 water elevation measurements indicate ground water flow toward the river. Elevation contours indicate that freshwater entering the site at the northern boundary flows south toward the river over the top of a deeper natural brine zone.

The deeper brine water results mostly from dissolution of the underlying salt beds of the Paradox Formation present beneath most of the site. Figure 4 presents a conceptual model of the subsurface hydrogeology along a representative streamline showing the interface between the deeper saltwater system and the overlying freshwater system. The saltwater interface is defined at the 35,000-mg/L TDS boundary. The transition from the saltwater to the freshwater system occurs over a short vertical distance and is, therefore, referred to as being “sharp.” The vertical position of the interface is in equilibrium because the buoyant force exerted by the brine is balanced by the weight of the overlying freshwater. In natural systems, little, if any, freshwater penetrates saltwater at the interface. The freshwater can be thought of as a liquid that “floats” upon a buoyant saltwater liquid. At the Moab Site, the interface extends across the site in a wedge shape, in which the deepest part of the interface is near the northwest boundary, and the shallowest depth is near the river. The position of the interface near the river is in dynamic equilibrium and probably shifts laterally and vertically in response to evapotranspiration by the tamarisk plant communities and the stage of the Colorado River. The interface may also shift vertically upward as a result of pumping from the shallow freshwater (e.g., during a pump-and-treat remediation) and cause the saltwater to rise to a higher elevation and intrude the freshwater. Saltwater intrusion would result in degradation of the overlying freshwater, which could adversely affect the tamarisk plant communities which are presumed to provide some beneficial phytoremediation at the site.

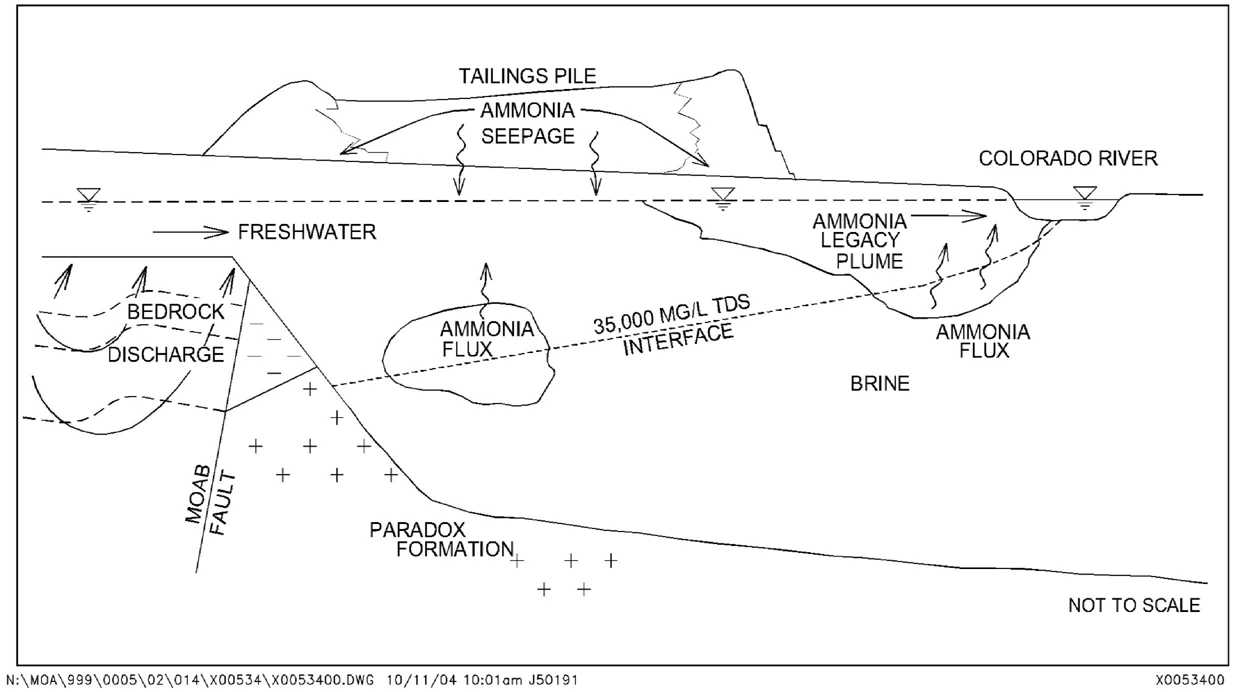

Figure 4. Conceptual Model, Saltwater/Freshwater Interface

Rising saltwater may also bring higher ammonia and salt concentrations to the surface and cause added contamination flux to the river. Low pumping rates and proper extraction well construction and pump location may prevent saltwater intrusion. Additional information on the hydrogeology of the site is presented in the SOWP (DOE 2003a).

Additional recharge to the site occurs through precipitation. The Paradox Formation is believed to be an impermeable boundary (bedrock aquitard) and does not contribute to the site water budget. An estimate of the annual steady-state water budget for each hydrologic component of the system is presented in Table 6. Short-term transient effects such as the small positive contribution to bank storage by recharge from the Colorado River during periods of high flow are not included. The estimates are represented with a large range of individual values, and the ranges of the total inflow and total outflow do not overlap, reflecting the uncertainty of the values and suggesting that the true water budget might lie between the two ranges. The SOWP (DOE 2003a) provides additional discussion of the ground water hydrology and water budget of the site.

Table 6**. Estimated Annual Water Budget for the Moab Site**

Flow Component	**Inflow (gpm)**	**Outflow (gpm)**
Areal Precipitation	16–65	N/A
Moab Wash	0.5–33	N/A
Glen Canyon Group	28–280	N/A
Tailings Pile	20	N/A
Evapotranspiration	N/A	200–500
Colorado River	N/A	300–600
Total	**65–400**	**500–1,100 (rounded)**

N/A = not applicable.

Ground Water Quality - The basin-fill aquifer underlying the site is divided into three hydrochemical facies: (1) an upper fresh to moderately saline facies (fresh Quaternary alluvium [Qal]) that has concentrations of TDS up to 10,000 mg/L, (2) an intermediate facies of very saline water (saline Qal), having TDS concentrations between 10,000 and 35,000 mg/L, and (3) a lower briny facies (brine Qal) that has TDS concentrations greater than 35,000 mg/L. All three facies existed beneath the site prior to milling activities. The SOWP (DOE 2003a) provides additional discussion of ground water geochemistry and water quality at the site.

The freshwater quickly becomes mixed with more saline water in the basin-fill aquifer as it enters the site from Moab Wash and flows toward the Colorado River. Salinity naturally increases with depth and distance from the freshwater source contribution from Moab Wash. Mixing of the two background water types (fresh upgradient water with the deeper depth saline water) influences the background water quality at the site. The result is a background water quality in the basin-fill aquifer that is highly variable both vertically and horizontally across the site.

Background conditions in the upper fresh Qal facies are characterized by low concentrations of uranium and other trace metals that are all below the EPA standards in 40 CFR 192. TDS concentrations range from 677 to 7,820 mg/L, which classifies the water quality as fresh to slightly saline. Background alkalinity as calcium carbonate ranges from 137 to 189 mg/L. There is no EPA standard for ammonia in 40 CFR 192. Ammonia–N concentrations are less than 1 mg/L. Sulfate concentrations range from 180 to 1,140 mg/L. Calcium concentrations range from 47 to 294 mg/L. Magnesium concentrations range from 31 to 188 mg/L. On average, the pH value of the upper fresh Qal facies is near neutral (7.7), and the redox condition is slightly oxidizing (oxidation-reduction potential is 186 millivolts [mV]).

Ground water concentration limits for arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, selenium, silver, uranium (combined U-234 and U-238), gross alpha (excluding radon and uranium), and radium (combined radium-226 and radium-228) are regulated by EPA standards (40 CFR 192). Of these constituents, the maximum concentrations detected for arsenic, cadmium, uranium, radium, gross alpha, nitrate, selenium, and molybdenum exceed EPA standards. The remaining regulated constituents (barium, chromium, lead, mercury, and silver) are all present at relatively low concentrations below EPA standards.

The areal distribution of uranium concentrations greater than 0.044 mg/L, interpolated and contoured on the upper surface of the ground water, were presented in the DEIS and depicted in Figure 3-10 of that document. The highest uranium concentrations are in the shallow ground water in the former millsite area. Cross-sectional views of the uranium plume and additional isoconcentration maps of uranium as a function of depth are provided in the SOWP (DOE 2003a). SMI (2001) suggested that the high uranium concentrations beneath the millsite are caused by waste leaking from the former wood chip disposal areas. Although the uranium plume is in an area where wood chip disposal was likely to have occurred, lithologic logs of borings installed in this area of the site do not indicate that they penetrated through the wood chip pits. Another possible source of the high uranium concentrations is the uranium ore stockpiles; however, samples collected from monitor wells nearest the largest known ore stockpiles have lower uranium concentrations. Whether the source of the high uranium concentrations in ground water samples is the wood chip pits, the ore stockpiles, or some other millsite-related release, it seems that some of the ground water contamination originates in the millsite area, independently of the tailings pile.

Although ammonia has no EPA standard in 40 CFR 192, it occurs at concentrations significantly greater than natural background, is one of the most prevalent contaminants in the ground water, and is the constituent of greatest ecological concern that is discharging to the Colorado River in backwater areas adjacent to the site. The areal distribution of ammonia concentrations greater than 50 mg/L, interpolated and contoured on the upper surface of the ground water, is presented in the DEIS and depicted in Figure 3-11 of that document. The highest concentrations in the shallow ground water, greater than 500 mg/L, appear near the down gradient edge of the pile and extend to and discharge to the Colorado River. The highest ammonia concentrations in surface water samples are detected in samples collected closest to the riverbank adjacent to the tailings pile and immediately downstream of Moab Wash. A comparison of ground water data with surface water data shows that, with few exceptions, concentrations of site-related constituents are much lower in the surface water than in the ground water. Ammonia concentrations in the river are approximately 2 orders of magnitude lower than in the ground water. Although available data are not adequate to establish an accurate dilution factor, these data do suggest that at least order-of-magnitude decreases in constituent concentrations can be expected as ground water discharges to the river. DOE recognizes that isolated pools or very shallow areas may be exceptions to this dilution, and claim that these may not be important aquatic habitats, as they are frequently cut off from the river and dry up, and fish mortality would be as likely from habitat limiting factors (e.g. physical factors and predation). The USFWS considers shallow areas ($\geq$2.5cm in depth) in backwaters and along the margin of flowing channels as habitats used by young native fish. If these shallow habitats are not subject to habitat limiting factors, they can potentially be very important to early life stages of endangered fish and therefore lower dilution rates could be harmful.

Relatively high ammonia concentrations in ground water also occur at depth beneath the tailings pile. During milling operations, the tailings pond contained fluids with TDS concentrations ranging from 50,000 to 150,000 mg/L. Because these salinities exceed 35,000 mg/L, they had sufficient density to migrate vertically downward through the freshwater system and into the brine. This downward migration of the tailings pond fluids into the saltwater system is believed to have created a reservoir of ammonia that now resides below the saltwater interface. This ammonia plume below the interface probably came to rest at an elevation where it was buoyed by brine having a similar density. Under present conditions, the ammonia plume beneath the saltwater interface represents a potential long-term source of ammonia to the freshwater system. The conceptual model presented in Figure 4 illustrates the ammonia source at the saltwater interface (basal flux), the legacy plume, and seepage of ammonia from tailings pore fluids.

Surface water contamination

Analytical results of samples collected adjacent to the site were compared to background concentrations and aquatic benchmarks to develop a list of contaminants of potential concern. The analytical results confirmed that ground water discharge from the Moab Site has caused localized degradation of surface water quality. As a result of that evaluation, ammonia, copper, manganese, sulfate, and uranium are considered contaminants of concern.

Concentrations of contaminants of potential concern in surface water samples vary widely, depending on sampling locations and river flow conditions. Concentrations are most likely to be elevated during periods of average to low river stages in areas where water is shallow and slow moving or pooled. Concentrations are also highest immediately adjacent to the riverbank. The constituents with concentrations that are most consistently elevated in samples from the Colorado River are ammonia and uranium. These will be discussed as indicators of site-related contamination. DOE reports ammonia concentrations as high as 300 mg/l detected in samples from areas next to the riverbank immediately downstream of Moab Wash.

Low river flows expose greater portions of the Moab Wash sandbar, creating increased backwater areas that allow for higher concentrations of ammonia in the surface water. However, a study completed in 2000 (SMI 2001) determined that during high flows, backwater areas are eliminated near the site, and ammonia concentrations near the shore are diluted to protective levels (within EPA's recommended total ammonia protection criteria), or loading is temporarily stopped by river water flowing into the aquifer because of the seasonally high river stage. This finding suggests that snowmelt runoff periods (May and June) may temporarily reduce the ammonia concentration in the Colorado River.

Because ground water gradients on both sides flow toward the river, it is likely that the presence of the ground water brine affects surface water quality. However, because process fluids disposed of in the former tailings pond contained some of the same constituents that occur in natural brines, distinguishing between naturally occurring constituents and site-related constituents in surface water is not straightforward. Increases in sodium, chloride, or dissolved solids content of river water (among other constituents) in the vicinity of the site, compared to background concentrations, could be a result of discharge of either site-related contaminated ground water or natural brines.

Toxic effects of ammonia

The toxic effects of ammonia to aquatic species are well documented. Thurston et al. (1983) documented that acute toxicity, as the 96-hour median lethal concentration (LC50), occurred in fathead minnow (*Pimephales promelas*) at ammonia concentrations ranging from 0.75 to 3.4 mg/l un-ionized ammonia (34-108 mg/l total ammonia nitrogen). DeGraeve et al. (1980) reported a 96-hour LC50 of 1.59 mg/l un-ionized ammonia for fathead minnow. Ammonia toxicity has been reported for numerous other nonsalmonid fishes. LC50's ranged from 0.14 to 4.2 mg/l un-ionized ammonia for these fishes (Thurston et al. 1983).

The documented chronic effects of ammonia toxicity include reduced growth rate (Rice and Bailey 1980, Burkhalter and Kaya 1977, Broderius and Smith 1979, McCormick et al. 1984, Robinette 1976, Smith 1972, Smith and Piper 1975, Smith et al. 1984, Swigert and Spacie 1983), reduced gamete production, body deformities and malformations (Smith 1984), and degenerative gill and kidney appearance and function (Burkhalter and Kaya 1977, Fromm 1970, Smart 1976, Thurston et al. 1978). Reported ammonia concentrations found to reduce growth rates, retard growth, reduce gamete production, or decrease body weight, ranged from 0.0024 mg/l, to 0.49 mg/l.

USGS conducted a site-specific risk assessment to determine if ground water entering the Colorado River from beneath the tailings pile could affect the endangered Colorado pikeminnow and razorback sucker (USGS 2002). Results indicate that during the low-flow period from August to March, ammonia levels exceed State of Utah standards. The area of contamination varies with hydrologic regime but in general is confined to an area less than 6,000 square yards (yd2). USGS found that the highest observed concentrations of ammonia occur at river flows of less than 5,000 cfs during the late summer, fall, and winter months. Flows above 5,000 cfs dilute ammonia concentrations to levels below those of toxicological concern.

Toxicity tests performed as part of the USGS risk assessment indicated that Colorado pikeminnow, razorback sucker, and fathead minnow had a 28-day lowest observed effect concentration (LOEC) value for mortality ranging from 2.19 to 4.35 mg/L total ammonia (pH = 8.25 and temperature = 25 ^{o}C). USGS estimated effects on individuals at concentrations as low as 0.17 mg/L un-ionized ammonia. Toxicity tests also indicate there were no differences in toxicity across pH within a given temperature. They found that Colorado pikeminnow were more sensitive to ammonia at lower temperatures (8^{o} C) than at an average condition (18^{o} C). On-site toxicity tests in low or no flow areas demonstrated that site waters were directly toxic to both the endangered Colorado pikeminnow and the fathead minnow.

Analyses for Effect of the Action and Species Response to the Proposed Action

DOE has indicated that many of the details of their preferred alternative will be determined after filing a Record of Decision and therefore the following effects analysis is based on DOE’s characterization of project effects as presented in their biological assessment.

We relied heavily on supplemental information presented in the EIS (DOE 2004) and SOWP (DOE 2003a) documents to assist in our analysis. In addition, we relied on information provided through the Upper Colorado River Endangered Fish Recovery Program, studies conducted by USGS (USGS 2002), University of Utah (Gardner and Solomon 2003, 2004) and comments provided by various agencies on the DEIS to complete our analyses.

Actions at the Moab Site:

Mechanical Disturbance. The impact to aquatic species due to construction and operations at the Moab Site would be from mechanical disturbances and loss of vegetation along the shoreline of the Moab Wash and Colorado River. Activities at the Moab Site would likely disturb about 8,100 ft of Colorado River shoreline. The vegetation along the shoreline of the tailings pile, consisting primarily of tamarisk, would be removed in order to excavate and remove contaminated materials (i.e., soils contaminated with residual radioactive material). The tamarisk along the banks of Moab Wash as it enters the Colorado River would likely be removed as well.

The effects of mechanical disturbance would include the loss of shade and cover over the shoreline and potentially a loss of surface stability that could lead to increased erosion and siltation into the wash and river. Impacts to threatened and endangered species due to these changes would be minimal. The shade and cover provided by the tamarisk is only along the edge of the river during high and moderate flows of the river. At low river flows, the shoreline vegetation provides no shade, and the flow into the wash is cut off. The potential also exists for water intake structures in the river to result in mortality to eggs, larvae, young-of-the-year, and juvenile life stages. DOE would minimize this potential by using one-quarter to three-eighths-inch screened mesh on water intake structures.

Effects from siltation and erosion into the river and wash could fill in backwater areas that may be important to macroinvertebrates and fish. Moab Wash has been documented as potential pikeminnow nursery habitat that could be affected by siltation and erosion (NPS 2003). Erosion along the river shoreline could create new backwater areas, but these would likely be temporary based on river stage.

Federally listed species that could be affected by the changes to the shoreline include the endangered Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. The Colorado River reach near the Moab Site has been designated as critical habitat (50 CFR 17.95) for two of the endangered fish: Colorado pikeminnow and razorback sucker. Juvenile and adult Colorado pikeminnow and stocked adult razorback sucker and bonytail have been collected near the Moab Site. Moab Wash and the riparian vegetation adjacent to the Colorado River potentially provide nursery habitat for young-of-the-year fish (NRC 1999, NPS 2003, UDWR 2003a). Erosion and siltation events that change the depth and configuration of these backwater areas are likely to diminish the quantity and quality (amount of available food items) of nursery habitats for endangered fish. Other fish, macroinvertebrates, and emergent plants associated with the backwater areas are also likely to be affected by erosion and siltation. DOE intends to prevent or reduce the effects of erosion by minimizing shoreline disruption, replacing vegetation, and installing erosion control devices. The USFWS sees these effects to physical habitat as short term in nature. Whereas, a temporary loss of a specific nursery habitat could result in some level of take of the species, we would assume displacement downstream to the next suitable habitat alone (i.e. without the added impact of exposure to elevated levels of surface water contamination) would not adversely affect these early life stages.

Noise. Noise from site construction and operations is not expected to affect the aquatic environment. Activities along the shoreline are likely to be of short duration and are not likely to cause macroinvertebrate or fish communities to avoid the area.

Other Human Disturbances. Aspects of human presence such as personnel or vehicle movement and supplemental lighting are not expected to affect the aquatic environment.

Water Depletions. Water depletion in the Colorado River as a result of remediation of the Moab Site would jeopardize the endangered Colorado River fishes. In accordance with the Cooperative Agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS 1987) all Section 7 consultations address depletion impacts. A key element of the program requires a one-time contribution of $16.30 per ac-ft (adjusted annually for inflation) based on the average annual depletion through activities at the site, to be paid to USFWS. DOE has identified an average annual depletion of 235 ac-ft / year. Depletions less than 4500 ac-ft/yr are considered "small depletions" by the Recovery Implementation Program. Depletion impacts to the Colorado River endangered fish from the proposed action will be addressed in the Conclusion section of this biological opinion.

Effects of Off-site Disposal at the Crescent Junction Site

We concur with DOE's determination that their off-site disposal alternative (excluding the ground water remediation component) may affect but is not likely to adversely affect the Colorado River fish with the exception of the effects associated with the Colorado River depletions. Water depletions reduce the ability of the river to create and maintain important habitats and reduce the frequency and duration of availability of these habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity. High spring flows inundate bottomland habitats and increase the nutrient supply and productivity of the river environment. Reduction of high spring flows from water storage reservoirs that store water during spring peak flows may reduce food supply. The effects of Colorado River depletions will be addressed separately in the Conclusion section.

DOE compared and contrasted the relative effects to the environment from disposing surface contamination on-site versus off-site in their DEIS. Several uncertainties were associated with capping the mill tailings onsite, including: the threat of the release of contaminants due to river flooding and river migration; the future dissolution of ammonia salts associated with the pile. As portrayed in the DEIS those uncertainties would be significantly reduced under an off-site disposal alternative. The USFWS recognizes that even after surface contaminants at the Moab Site were removed and the Moab Site was reclaimed to EPA standards future river channel avulsion could result in the release of some contamination to the surface flows of the Colorado River. However the USFWS believes that off-site disposal of surface contamination at the Moab Site, as proposed by DOE, represents the most conservative approach to protecting listed species and their habitat.

In their biological assessment, DOE indicates that further study of the site and the transportation method selected would be required to fully address all endangered species concerns. As DOE continues to develop their RAP, the USFWS will determine if further Section 7 consultation is needed.

Effects Associated with the Ground Water Remediation Program

DOE proposes an active ground water remediation program as part of their preferred alternative. All remediation activities would occur within the existing millsite boundary. DOE estimates that the active remediation system would extract and treat ground water for 75 years to maintain surface water quality goals.

DOE and the USFWS, in discussions during the summer of 2003, agreed to an ammonia-based groundwater remediation goal of 3mg/l. The USFWS conferred with the USGS on this ground water remediation target in January, 2004. In his email response to our inquiry dated January 8, 2004, Mr. James Fairchild, USGS, Research Ecologist, concurred that the 3mg/l ammonia target was reasonable based on information that suggested the ground water pH would be around 7.2 which should decrease the uninonzed fraction. In addition there should be some microbial activity to oxidize the ammonia to nitrate. Mr. Fairchild's concern, however, was that a "goal" is not the same as a statutory criteria. The 3-mg/L concentration represents a 2- to 3-order-of-magnitude decrease in the center of the ammonia plume and is expected to result in a corresponding decrease in surface water concentrations. The overall groundwater remediation goal is expected to put DOE in compliance with the acute and chronic benchmarks based on ambient pH and temperature as stipulated in the National Recommended Water Quality Criteria (NWQC) (EPA 2002) and currently proposed Utah Water Quality Standards (UAC 2003, UDEQ 2003). The groundwater target, coupled with DOE's estimated average 10-fold dilution as groundwater mixes with surface water is expected to result in compliance with both acute and chronic ammonia standards in the river everywhere adjacent to the site. Potential synergistic effects between contaminants would be reduced through ground water remediation. Continued monitoring during active ground water remediation would be necessary to verify that contaminant concentrations remained below both acute and chronic benchmarks for aquatic species.

DOE has determined, and the Service concurs, that during the pre-remediation phase, critical habitat for the Colorado pikeminnow and the razorback sucker would likely continue to be adversely modified by historical contamination. The following endangered fish species and their life stages are most likely to be directly and adversely affected by site-related contamination: Colorado pikeminnow (all life stages with emphasis on drifting larvae and young-of-the-year), razorback sucker (stocked juveniles and adults, and naturally produced larvae and young-of-the-year) and bonytail (stocked juveniles and adults, and naturally produced larvae and young-of-the-year) (USFWS 2004a). The closest population of humpback chub occurs 60 miles downriver in Cataract Canyon and could be affected by a large release of surface contaminants. Under the most extreme catastrophic release of surface contaminants (prior to completion of off-site disposal) the USFWS believes there could be lethal effects in Cataract Canyon. Conversely, we do not believe current levels of ground water contamination are causing measureable effects there.

DOE, in consultation with USFWS, has implemented and will continue to implement initial and interim actions to reduce the potential for “take” until the selected remedial action and methods are fully implemented. The time frame required for the selection and implementation of remedial actions and methods, during which the take could occur, is anticipated to be a maximum of 10 years from the date of the ROD. A reduction in contaminant concentrations in surface water could be observed significantly sooner than the 10-year time frame as a result of interim actions.

DOE predicts that during the remediation and post-remediation phases of ground water remediation effects on fish species and associated critical habitat would likely be insignificant or neutral. The USFWS will rely on ground water and surface water monitoring to determine if remediation goals are met. USFWS would be consulted at least annually on the results of monitoring.

In their biological assessment, DOE addressed the effects of flooding on ground water remediation. Catastrophic flooding could affect the aquatic environment by flooding the ground water remediation systems. The interim action and proposed ground water remediation includes wells or shallow trenches located between the foot of the pile and the river’s edge. The location for these systems is in the 100-year floodplain. If a flood were to inundate the remediation systems, ground water with contaminant concentrations exceeding the aquatic benchmarks could pass through the region toward the river. DOE expects that remediation and monitoring systems would be quickly restored after the flood waters receded. In the event of any disruption in groundwater remediation operations DOE will notify the USFWS and both agencies will determine how to proceed.

The Service and DOE recognize several areas of uncertainty associated with ground water remediation. DOE’s conceptual model does not account for site related contaminants affecting habitats on the south side of the river, i.e. the Matheson Wetland Preserve. In a recent effort to describe the water budget at the Scott M. Matheson Wetland Preserve, Gardner and Solomon (2004) developed studies to quantify and investigate: (1) sources of water to the wetland, (2) seasonal changes in hydrologic patterns, (3) bulk wetland evapotranspiration, and (4) the hydrologic connection between the wetland an the Moab Mill Tailings. Field studies were conducted from the fall of 2002 to the spring of 2004. Uranium and ammonia concentrations were sampled along with an analysis of tritium, oxygen, and deuterium isotopic ratios to explore groundwater connectivity between the wetland and the mill tailings directly across the river. Gardner and Solomon concluded that brines sourced from across the river had migrated beneath the river in the highly permeable channel gravels. They claimed that brine migration was further substantiated by the uranium distribution, which was coincident with equivalent freshwater head gradients (EFH) during the summer of 2003. Dr. Solomon (personal communication via electronic mail of May 3, 2005) recognized uncertainty in their EFH analysis and in their report the authors were uncertain whether the passage of fluids beneath the river through highly conductive channel deposits is ongoing or a response to discontinuous driving forces (seasonal or otherwise). Regardless, they concluded that fluids, at some point in time, migrated from north to south beneath the Colorado River.

The DOI referenced Gardner and Solomon's report in our comments to DOE on their draft EIS. DOE provided a critique of Gardner and Solomon (2004) in their response to DOI's comments. In their critique, DOE took exception to the author's conclusions based on their own investigations into groundwater flow at the Moab Site. DOE does, however, agree with the authors of the report and the USFWS that this is an area of uncertainty that warrants further investigation.

The State of Utah DEQ maintains that there is sufficient information currently available to support a ground water remediation goal that is consistent with the chronic ammonia standard of 0.6 mg/l total N as opposed to the acute standard of 3 mg/l. In their EIS comment letter to DOE dated February 17, 2005, they explain their position as follows:

> <u>*Mixing Zone Premise: Lack of Turbulent Flow*</u> *– acute standards are applied to surface water quality problems under the assumption that 1) open channel turbulence will provide for a mixing zone to dilute or otherwise reduce the contaminant concentrations from a point source discharge, and 2) the mixing zone will be limited in its dimensions relative to the river's channel, i.e., less wide than the river channel and limited in longitudinal length (see Utah Water Quality Rules, UAC R317-2-5). However, the backwater areas in question only access the river channel at the habitat's downstream end. Hence, there is no open channel turbulence inside the backwater area. Instead, the backwater areas are recharged by infiltrating groundwater from the bank, or by river water infiltrating thru the barrier sand bar. Both of these sources of recharge constitute laminar flow and not turbulent conditions. Hence the acute standard is not applicable to an environment where water flow is largely laminar.*
>
> <u>*Avoidance Behavior Assumption*</u> *– another critical assumption in the application of acute standards to surface water quality problems is that adult fish can avoid the toxicity of the mixing zone by swimming around it (avoidance behavior). However in the case of the backwater areas in questions, larval fish that will be deposited there by the currents do not have the capability to resist moving water. Consequently, they cannot exhibit any avoidance behavior. Given these circumstances only the chronic standard is appropriate, 0.6 mg/l.*
>
> <u>*Exposure Time and Dilution Criteria*</u> *– the acute standards are designed for a 1-hour exposure to the fish (see Utah Water Quality Rules, UAC R317-6-2, Table 2.14.2). In contrast the chronic standard is designed for a 4-hour exposure period (ibid.). In the case of the backwater areas, the habitat will serve as a nursery for the larval fish in question. Consequently, they will reside there for weeks if not months. As a result, only the chronic standard, 0.6 mg/l, is applicable. For these reasons, the chronic ammonia-nitrogen*

> *standard must be applied to the backwater habitats in question. We understand that water quality monitoring of these backwater areas is challenging, largely due to their transient nature; and that therefore it is preferred to monitor groundwater quality as a means of verifying compliance. We have also concluded that the DOE evaluation of the transfer mechanism between groundwater and the backwater areas is incomplete. Errors have also been found in DOE's claim for a 10-fold groundwater to surface water dilution factor. These errors are discussed in detail below. Until these errors are resolved, and without confirmation on how dilution, dispersion, retardation, or biologic decay will reduce the ammonia concentrations during this groundwater to surface water transition, it is conservative and protective of the environment to apply the chronic (0.6 mg/l) standard as a groundwater cleanup goal.*

In their EIS comments, UDEQ called into question DOE's calculations of the dilution factor. UDEQ suggested that a better understanding of the time dependent dynamic between ground water / surface water interactions as a function of river stage is required. It was UDEQ's contention that insufficient quality assurances were applied to the data used to develop the dilution factor. UDEQ further cautioned that the amount of variability associated with the data used to develop the dilution factor in backwater habitats was considerable and suggested non-normal distribution. They advised further study of these issues.

The USFWS has considered all of UDEQ's comments in our analysis of the effects to listed species associated with ground water remediation and we agree that many warrant further study (see Incidental Take Statement). Based on our review of the available information, and with recognition that there are uncertainties in both DOE's and UDEQ's analyses, the Service has determined that DOE's premise that 3mg/l ammonia in groundwater will result in protective concentrations in all surface water habitats presents a reasonable approach to the problem.

Another basic premise of DOE's groundwater remediation program is the assumption that if ammonia concentrations are reduced to protective levels the other contaminants of concern will be reduced as well. In their comments on the EIS, USEPA points out that this assumption remains relatively untested and that the other constituents of concern have different solution chemistries and sorptive characteristics and consequently are likely to have different fate and transport projections. The USFWS agrees that this assumption warrants further investigation, which we address in our Incidental Take Statement.

Cumulative Effects

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to secton 7 of the Endangered Species Act. In the action area, the Colorado River flows mostly through federal land. We are unaware of future state or private actions that are in the planning that would not require Section 7 consultation. For this reason, no cumulative effects are anticipated on the endangered species or designated critical habitat in the action area.

CONCLUSION

Project Depletions of the Colorado River

After reviewing the current status of the Colorado River fish, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the USFWS's biological opinion that average annual depletions of 235 ac-ft of Colorado River water will jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker will likely result in destruction or adverse modification of critical habitat. The USFWS has developed the following reasonable and prudent alternative to deal with water depletion impacts to the four endangered Colorado River fishes.

Reasonable and Prudent Alternative

On January 21-22, 1988, the Secretary of the Interior; the Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration were cosigners of a Cooperative Agreement to implement the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (USFWS 1987). An objective of the Recovery Program was to identify reasonable and prudent alternatives that would ensure the survival and recovery of the listed species while providing for new water development in the Upper Basin.

The following excerpts are pertinent to the consultation because they summarize portions of the Recovery Program that address depletion impacts, section 7 consultation, and project proponent responsibilities:

"All future Section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the USFWS by water project proponents in the amount of $10.00 per ac-ft based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the current figure is $16.30 per ac-ft] . . . . Concurrently with the completion of the Federal action which initiated the consultation, e.g., . . . issuance of a 404 permit, 10 percent of the total contribution will be provided. The balance will be …due at the time the construction commences . . . ."

It is important to note that these provisions of the Recovery Program were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The Recovery Program further states:

". . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to ensure instream flows . . . . Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, the USFWS will consider these elements under Section 7 consultation as offsetting project depletion impacts."

Thus, the USFWS has determined that project depletion impacts, which the USFWS has consistently maintained are likely to jeopardize the listed fishes, can be offset by (a) the water project proponent's one-time contribution to the Recovery Program in the amount of $16.30 per ac-ft of the project's average annual depletion, (b) appropriate legal protection of instream flows pursuant to State law, and accomplishment of activities necessary to recover the endangered fishes as specified under the Recovery Implementation Program Recovery Action Plan. The USFWS believes it is essential that protection of instream flows proceed expeditiously, before significant additional water depletions occur.

With respect to (a) above (i.e., depletion charge), the applicant will make a one-time payment which has been calculated by multiplying the project's average annual depletion (235 ac-ft) by the depletion charge in effect at the time payment is made. At the time of this consultation, DOE has identified a range of depletions (130-235 ac-ft) associated with the proposed action; a final depletion figure will be developed as they develop their RAP. We recommend that DOE pay the depletion charges as soon as the final depletion amount is determined. For Fiscal Year 2005 (October 1, 2004, to September 30, 2005), the depletion charge is $16.30 per ac-ft for the average annual depletion which equals a total payment of $ 3,830.50 for this project. This amount will be adjusted annually for inflation on October 1 of each year based on the previous year's Composite Consumer Price Index. The USFWS will notify the applicant of any change in the depletion charge by September 1 of each year. Ten percent of the total contribution ($383), or total payment, will be provided to the USFWS's designated agent, the National Wildlife Foundation at the time of issuance of the Federal approvals from the Department of Energy. The balance will be due at the time the construction commences. The payment will be included by the DOE as a permit stipulation. Fifty percent of the funds will be used for acquisition of water rights to meet the instream flow needs of the endangered fishes (unless otherwise recommended by the Implementation Committee); the balance will be used to support other recovery activities for the Colorado River endangered fishes. All payments should be made to the National Fish and Wildlife Foundation.

National Fish and Wildlife Foundation
28 Second Street, 6th Floor
San Francisco, California 94105

Each payment is to be accompanied by a cover letter that identifies the project and biological opinion that requires the payment, the amount of payment enclosed, check number, and any special conditions identified in the biological opinion relative to disbursement or use of the funds (there are none in this instance). The cover letter also shall identify the name and address of the payor, the name and address of the Federal Agency responsible for authorizing the project, and the address of the USFWS office issuing the biological opinion. This information will be used by the Foundation to notify the payor, the lead Federal Agency, and the USFWS that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

In order to further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program, an additional section 7 agreement and Recovery Plan addressing section 7 consultation on depletion impacts was developed (USFWS 1993b). The section 7 agreement establishes a framework for conducting all future section 7 consultations on depletion impacts related to new projects and those associated with historic projects in the Upper Basin. Procedures outlined in the section 7 agreement will be used in conjunction with the Recovery Plan to determine if sufficient progress is being accomplished in the recovery of the endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative to avoid jeopardy. The Recovery Plan was finalized on October 15, 1993, and is reviewed annually.

In accordance with the agreement, the USFWS has agreed to assess impacts of projects that require section 7 consultation and determine if progress toward recovery has been sufficient for the Recovery Program to serve as a reasonable and prudent alternative. If sufficient progress is being achieved, biological opinions will be written to identify activities and accomplishments of the Recovery Program that support it as a reasonable and prudent alternative. If sufficient progress in the recovery of the endangered fishes has not been achieved by the Recovery Program, actions from the Recovery Plan will be identified which must be completed to avoid jeopardy to the endangered fishes. For historic projects, these actions will serve as the reasonable and prudent alternative as long as they are completed according to the schedule identified in the Recovery Plan. For new projects, these actions will serve as the reasonable and prudent alternative so long as they are completed before the impact of the project occurs. The Atlas mill tailings reclamation project is considered a new project.

The evaluation by the USFWS to determine if sufficient progress has been achieved considered (a) actions which result in a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction; (b) status of fish populations; adequacy of flows; and (d) magnitude of the project impact. In addition, the USFWS considered support activities (funding, research, information and education, etc.) of the Recovery Program if they help achieve a measurable population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction. The USFWS evaluated progress separately for the Colorado River and Green River subbasins; however, it gave due consideration to progress throughout the Upper Basin in evaluating progress toward recovery.

Based on current Recovery Program accomplishments and the expectation that the Recovery Plan will be fully implemented in a timely manner, the USFWS determined that sufficient progress has been achieved under the Recovery Program so that it could serve as the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by the impacts caused by the water depletion associated with this permit. For historic projects, the responsibility for implementation of all elements of the reasonable and prudent alternative rests with the Recovery Program participants, not the individual project proponent. All actions must be implemented according to the time schedule specified in the Plan. For new projects, the responsibility for implementation of elements of the reasonable and prudent alternative is shared by the Recovery Program and the applicant. Recovery Program participants are responsible for carrying out activities outlined in the Recovery Plan.

The USFWS should condition the permit to retain jurisdiction in the event that the Recovery Program is unable to implement the Recovery Plan in a timely manner. In that case, as long as the lead Federal Agency has discretionary authority over the project, reinitiation of section 7 consultation may be required so that a new reasonable and prudent alternative can be developed by the USFWS.

The above Reasonable and Prudent Alternative involves time frames that must be met to avoid jeopardy to the endangered fish. Because these time frames are critical to meeting the stipulations for removing the jeopardy to the endangered fish, the DOE shall reinitiate consultation if any of the time frames are not met.

<u>Off-Site Disposal of Surface Contamination at the Crescent Junction Site and Ground Water Remediation at the Moab Site</u>

After reviewing the current status of the Colorado River fish, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the USFWS's biological opinion that this proposed action alternative will not likely jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and is not likely to result in destruction or adverse modification of critical habitat. The USFWS concludes that the proposed action to dispose of tailings (i.e. surface contamination) off-site would reduce negative effects associated with the ongoing contamination of the Colorado River near the Moab Site, and eliminate the potential for future catastrophic events associated with river flooding and river migration The proposed action for ground water remediation at the Moab Site would address the effects of ground water contaminants impacting endangered fish in the Colorado River. There would be adverse effects associated with the current levels of groundwater contamination until ground water remediation is fully implements, assuming the effects are not minimized by existing interim actions. The USFWS has determined that the amount of take that is occurring in the near shore habitats will not jeopardize the Colorado River fish. Previous research has shown that drifting larval Colorado River fish are equally distributed throughout the river channel. The Service believes that only a small percentage of the drifting larval contingent would be exposed to unsafe contaminant levels, and that DOE has already reduced impacts through implementation of the interim remedial actions.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken so that they become binding conditions of any Federal discretionary activity, for the exemption in section 7(o)(2) to apply. The participating Federal Agencies have a continuing duty to monitor the activity covered by this Incidental Take Statement. If the DOE 1) fails to assume and implement the terms and conditions or 2) fails to retain oversight to ensure compliance with the terms and conditions, the protective coverage of section 7(o)(2) may lapse for the projects covered by this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE

The listed Colorado River fish (Colorado pikeminnow, humpback chub, bonytail, and razorback sucker) are the only species covered under this Incidental Take Statement and only take associated with the groundwater remediation component of the proposed action is covered. Recent studies have demonstrated that ammonia concentrations in near shore habitats exceed acute and chronic standards for the protection of aquatic species from ammonia toxicity. A report of dead and dying fish (nonnative cyprinids) in a backwater immediately downstream of Moab Wash was transmitted to the USFWS in November, 2004. DOE was not able to make a strong cause /effect relationship based on available water quality data, but we (DOE and USFWS) assume the incident was contaminant related.

DOE has proposed the development and implementation of a groundwater remediation program that will reduce ammonia concentrations to protective levels in all surface water habitats. Based on data collected and analyzed by DOE and others, DOE assumes that by reducing near surface groundwater ammonia concentrations to 3 mg/l they will be able to achieve chronic standards (0.6 mg/l ammonia) in all habitats. The USFWS is operating under the same assumption.

DOE has projected that within 5 years of issuing a Record of Decision that design, procurement, testing, construction, and implementation of an active ground water remediation system would be complete. Following implementation of the system, DOE estimates that as much as an additional 5 years would be required to reduce concentrations of contaminants in the surface water to levels that are protective of aquatic species in the Colorado River. In this Incidental Take Statement, the USFWS is covering incidental take of Colorado River fish associated with exposure to non-protective concentrations of contaminants in near shore habitats along the north bank of the Colorado River at and downstream of the Moab Site for ten years from finalization of the biological opinion. In their compliance documents DOE suggests, based on preliminary results from their interim ground water remediation program, that contaminant levels may be reduced to protective levels in less than 10 years. The USFWS will work closely with DOE to implement an effective ground water remediation program sooner than 10 years if possible.

During each year of this ten year period, the USFWS anticipates that as many as three (3) Age-0 Colorado pikeminnow, one (1) Age-0 humpback chub, one (1) Age-0 razorback sucker, and one (1) Age-0 bonytail could be taken in low velocity shoreline habitats within a 0.5 five mile reach of the Colorado River (Moab Wash as the upstream terminus) as result of this proposed action. The Service considers Age-0 to be $\leq$ 40 mm Total Length. The incidental take is expected to be in the form of harm (death or injury) due to exposure to non-protective levels of contamination (most likely ammonia) or due to entrainment at DOE's Colorado River pumps. No take of older life stages is anticipated, based on data that indicate harmful concentrations are most likely to occur in backwater or other low velocity habitats and larger fish would be more capable of avoiding entrainment. Low velocity habitats are used preferentially by early life stages of the endangered species, and less so by older / larger fish.

EFFECT OF THE TAKE

In the accompanying biological opinion, the USFWS determined that the anticipated and declining level of incidental take associated with groundwater contamination at the Moab Site for ten years following finalization of this biological opinion is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

Based on DOE's analyses, our review of the subject documents and recent comments from the DOI and other agencies on the DEIS, the USFWS recognizes several uncertainties associated with the proposed ground water remediation program. Until protective levels of contamination are achieved in all surface water habitats in the Colorado River the Service believes some level of take of the endangered Colorado River fish species will occur. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the endangered Colorado River fishes:

1. Monitor backwater habitats near the Moab Site for any indication of fish being affected by surface water contamination.

2. Evaluate the effectiveness of their initial action (diluting non-protective contaminant concentrations in backwater habitats by pumping clean river water).

3. Address uncertainties associated with the ground water remediation program.

4. Reduce effects of surface water contamination in habitats along the south bank of the Colorado River if necessary.

5. Reduce the effects of entrainment at all project pumping sites.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the DOE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure (1): DOE in coordination with the USFWS will develop a biota monitoring plan (within six months of the ROD) for the purpose of observing and reporting dead or stressed fish to state and federal fish and wildlife offices (contact information below). Observations should occur from Moab Wash downstream approximately 1200 feet. If professional biologists are unavailable we require DOE or other on-site personnel to preserve specimens (25 fish or 10% of the total estimated number of dead fish; whichever is greater) in alcohol (50% isopropyl – rubbing alcohol) or on ice, but not frozen. Contact information:

   Utah Division of Wildlife Resources
   Moab Field Station
   1165 South HWY 191
   Moab, Utah 84532
   435-259-3780

   USFWS Utah Field Office
   2369 West Orton Circle, Suite 50
   West Valley City, Utah 84119
   801-975-3330

2. To implement Reasonable and Prudent Measure (2): DOE has the infrastructure in place to implement an "initial action" (pumping water from the flowing river into affected backwaters), which the USFWS agrees may be a reasonable, immediate measure to minimize take should water quality monitoring data indicate non-protective levels of contamination in backwater habitats during critical period of the summer. DOE will develop protocols and parameters (within 12 months of the ROD) that address timing and field techniques to implement the initial action. These protocols shall seek to minimize potential adverse effects associated with the initial action itself: temperature shock, re-suspension of fine sediments, elevated BOD, turbulence, etc. The development of these protocols and any field studies needed to support them shall be identified in the Water Quality Study Plan (see RPM #3; T&C #3).

3. To implement Reasonable and Prudent Measure (3): DOE, in coordination with USFWS, will develop data quality objectives within 6 months of the ROD, and will develop a Water Quality Study Plan (WQSP) within 18 months of the finalization of the ROD that evaluates / determines: 1) the effectiveness of current and expanded ground water remediation efforts; 2) the validity of the purported 10-fold ground water to surface water dilution factor; 3) compliance with achieving the target goal of 3 mg/L acute in ground water which is anticipated to meet chronic ammonia standards (0.6 mg/l) in all habitats

adjacent to the Moab site; assuming background does not exceed 0.6 mg/L. Background concentrations will be defined as those found in habitats upstream of the Hwy 191 bridge; 4) the validity of the assumption that by reducing concentrations of ammonia the other constituents of concern (manganese, sulfate, uranium, copper, and selenium) will also be reduced to protective levels; 5) the requirements and schedule for DOE's reporting to the USFWS; 6) if refinement of the conceptual model is necessary; and 7) issues identified in T&C No. 2 and 4. The Service will require a third party review of the WQSP.

4. To implement Reasonable and Prudent Measure (4): Independent studies conducted by Gardner and Solomon (University of Utah) do not support DOE's data and studies regarding the effects of Moab site contaminants on the Matheson Wetland Preserve. DOE will continue to investigate the potential for contaminants to be affecting the Matheson Wetland Preserve. Should data indicate that contaminants are, or are likely to affect surface water habitats on the south side of the river, DOE would consult with the USFWS concerning the need to expand ground water remediation efforts. Monitoring of the south side of the river will need to be addressed in the WQSP (see T&C No. 3).

5. To implement Reasonable and Prudent Measure (5): To reduce the likelihood of entraining young of the year native fish, DOE will continue to screen all pump intakes with ¼" diameter mesh material. DOE will avoid drawing water from low velocity habitats from June 1 through August 31.

CONSERVATION RECOMMENDATIONS

If the USFWS determines that ground water remediation as proposed is not effective in achieving the targeted goal, alternative approaches to reduce take may need to be considered. In preparation for that unlikely event, the USFWS recommends that DOE work closely with USFWS to evaluate the following options.

1. Reduce threats associated with surface water contamination at the Moab Site through dilution, i.e. increased base flows. The USFWS believes that a plausible alternative solution to the threat of ground water contamination would be to increase Colorado River flows upstream of the Moab Site throughout the summer, autumn and winter base flow period. DOE would need to identify an upstream source(s) of water and then secure that flow to the Moab Site through purchase, lease, or other agreement (if available). By increasing base flows secondary and primary productivity would presumably increase throughout the river. Increased productivity could potentially result in increased larval endangered fish production. In addition, an increase in base flows, over the baseline conditions would result in some dilution effect at the Moab Site.

2. If river dilution were pursued, DOE should also explore options to reduce threats of surface water contamination in low velocity habitats adjacent to the Moab Site by reducing endangered fish access to those habitats. DOE and the Service should consider, among other options, manipulating access to potentially dangerous habitats near the

Mr. Donald Metzler

Moab Site and compensate for that loss of nursery habitat area on a 1:1 basis at a nearby location.

REINITIATION NOTICE

This concludes formal consultation on the subject action. As provided in 50 CFR sec. 402.16, reinitiation of formal consultation is required for projects where discretionary Federal Agency involvement or control over the action has been retained (or is authorized by law) and under the following conditions:

1. The amount or extent of take specified in the Incidental Take Statement for this opinion is exceeded.

2. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. In preparing this opinion, the USFWS describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "EFFECTS OF THE ACTION." New information would include, but is not limited to, not achieving contaminant levels that are protective of aquatic life.

3. The section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion.

4. The USFWS lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under this opinion may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the USFWS will reinitiate consultation on the biological opinion as required by its section 7 regulations.

If we can be of any further assistance, please contact me at Tom Chart at (801)975-3330 extension 124 or extension 144, respectively.

Sincerely,

Henry R. Maddux
Field Supervisor

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